

R.M.U. USE ONLY
PROBLEM STATEMENT NO:
DATE OF RECEIPT:



STAGE I RESEARCH PROBLEM STATEMENT

I. PROBLEM TITLE (required):

Stress Transfer, Beyond the Strand Development Length of Pre-stressed Concrete Members, and its Effect on Quantifying the Residual Pre-Stressing Force.

II. PROBLEM STATEMENT (required):

At present, there is a need for determining bridge load ratings on pre-stressed bridges that are in service. According to the Federal Highway Administration, "States use the ratings in prioritizing projects, distributing bridge funds to local governments, posting bridges, and issuing load permits."

Bridge load ratings are affected by the residual pre-stressing force in the pre-stressed bridge girders. Recently, the Utah University Transportation Center and the Utah Department of Transportation generated a field-worthy, non-destructive approach aimed at quantifying the residual pre-stressing force of pre-stressed concrete girders. This approach was applied to eight pre-stressed girders that were salvaged from a decommissioned bridge after approximately 40 years of service. Results were shown to consistently validate the new approach, so long as paired readings, obtained in the field, were 1) located equidistant from the mid-span of each girder and 2) these readings are averaged with one another on a per girder basis.

The two conditions mentioned above indicate that beyond the strand development length, the stress transfer from the pre-stressing strands to the surrounding concrete may not be uniformly distributed through the length of the concrete member, a common assumption. In light of this finding, implications for existing and newly proposed field-worthy methods arise when directly quantifying residual pre-stressing force. By addressing this issue, bridge inspectors and researchers are that much closer to applying this technique on in-service bridges.

III. RESEARCH PROPOSED (required):

The proposed research aims to evaluate pre-stress losses over time via internal instrumentation. Particular attention will be given to the pre-stressing force as it is transferred through the length of a member, beyond the development length. In addition to on going monitoring, the changes in pre-stressing force through all pertinent phases of construction will be investigated.

During the initial phase of this project, equipment shall be ordered and students will gain familiarity with associated software, hardware, and equipment. Students and key personnel will then be on hand to instrument the pre-stressed, concrete members at the casting yard and the long-term monitoring program will commence. Scheduled site visits can include but are not limited to de-stressing, curing, and final placement. Once construction is complete, monthly site visits shall be conducted until readings are shown to stabilize. Thereafter, measured and calculated values will be compared and the findings shall be summarized in a report or presentation to the Montana Department of Transportation.

IV. IT COMPONENT (required):

The work proposed herein does not require IT hardware, software or support.

V. URGENCY AND EXPECTED BENEFITS (required):

On a global scale, according to the Federal Highway Administration, "Load ratings are relied upon and used extensively by the FHWA and others in the preparation of highway needs studies, congressional reporting, cost allocation studies, truck size and weight studies, and numerous other bridge management tasks." To this end, this research will have an impact for field inspectors and researchers who are interested in directly quantifying bridge load ratings by implementing non-destructive, field-worthy techniques.

On more of a local scale, pending the outcome of this research, a cost savings can be realized through reductions in both field labor and external instrumentation required to determine levels of residual pre-stressing force. To this end, the existing and newly proposed methodologies can be revisited. For instance, a less costly, albeit more conservative field measurement may be preferred to a more costly, more defined field measurement. Indirect benefits associated with a long-term bridge-monitoring project of this nature include student exposure to real-world problems and educational class field outings. Additionally, this project presents a unique opportunity for Montana Tech to collaborate with both Montana State University and the Montana Department of Transportation.

VI. IMPLEMENTATION PLAN (required):

Ultimately, MDT will be able to use the methodology developed in this study to measure pre-stress losses in pre-stress stringer bridges directly and then use this knowledge to better analyze their load carrying capacity. Researchers will work directly with MDT in improving and implementing this methodology, which will be fully documented in the final report for the project.

VII. SUBMITTED BY: (required)

NAME Brian Kukay¹, Mike Berry², and Jerry Stephens³
TITLE Assistant Professor^{1,2}, Professor³
AFFILIATION General Engineering Program Montana Tech¹, Civil Engineering Program MSU/Western Transportation Institute^{2,3}
ADDRESS 1300 West Park Street Butte, MT 59701¹, PO Box 174250, Bozeman, MT 59717^{2,3}

PHONE NO. (406)496-4517¹, (406) 994-1566², (406) 496-4517³
E-MAIL bkukay@mtech.edu¹, berry@ce.montana.edu², and jerrys@ce.montana.edu³

VIII. CHAMPION: (Must be internal to MDT)

NAME _____
TITLE _____
AFFILIATION _____
ADDRESS _____

PHONE NO. _____
E-MAIL _____

IX. SPONSOR(S): (Internal to MDT, Division Administrator or higher)

NAME(S) _____
PHONE #(S) _____
E-MAIL(S) _____

Note: Submitter may attach continuation sheets if necessary.